CALIFORNIA'S OPPORTUNITY TO ACHIEVE IMPROVED FLOOD MANAGEMENT AND MAJOR ECOSYSTEM RESTORATION.

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A. SUMMARY

The January 1997 flood presents us with a unique opportunity to propose a new flood management solution that provides greater hazard reduction benefits for Central Valley communities, with greater reliability and at lower cost than continued reliance on the present flawed and unreliable flood control system. This solution, which fully integrates flood management with river and watershed management, will also enable the large scale restoration of habitat for wetlands, waterfowl, and fish that have been largely destroyed by the construction of this same flood control system. It can be argued that this solution is the only solution, as there is now every indication that even with massive new expenditures on more structural flood control engineering works, there is no assurance that the present system would be able to prevent the inevitable catastrophic flood which is likely to occur within the next century.

B. BACKGROUND

The rivers of the Central Valley of California have the world's most comprehensive and highly engineered flood control system. This system was constructed mainly by the federal government over the last 80 years and consists of a complex of flood control dams, levees, and flood bypasses. Since the system was completed in the late 1970's, it has been tested by major rainfloods twice; in February 1986 and now in January 1997. In both of these flood events significant inadequacies in the operation, maintenance and design of the system were revealed, resulting in several billions of dollars of flood damages. Most seriously the mis-operation of Folsom dam in 1986 caused a near catastrophe for the City of Sacramento; and the predictable but unanticipated large flood spills from New Don Pedro and Friant dams in the 1997 flood created large flood waves that caused multiple ruptures in levees as they traveled downstream.

Even as this system was being completed it was becoming obsolete. By the 1970's the U.S. Government had finally recognized the futility and limitations of an exclusive reliance on an expensive strategy of attempting to "control" floods through massive engineering works. It was realized that flood control ignored the need

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to address factors such as inappropriate land use that were causing the steady escalation of flood damages experienced in the U.S. since the 1944 Flood Control Act. Starting with the passage of the 1968 Flood Insurance Act a series of new policies were enacted adopting flood plain management approaches. Unfortunately during the 1980's and 1990's, at both the state and federal level these initiatives languished, but since the 1993 Mississippi floods the validity and utility of flood management as opposed to flood control strategies has been confirmed by federal agencies and professional organizations.

The construction of the massive water control system of the Central Valley caused major ecosystem declines and extinctions that were only understood or acknowledged within the last two decades. With the passage of the 1992 Central Valley Project Improvement Act, and the signing of the 1994 Bay Delta Accords, there are now new State and Federal initiatives being formulated to restore fish, wildlife and wetlands. These initiatives are focussing on the restoration and management of flows and habitat in the river and estuary system.

C. A FLAWED FLOOD CONTROL SYSTEM

The flood control systems of the Sacramento and San Joaquin Rivers have had built into their design, serious intrinsic flaws, that frustrate achievement of their primary design objective, which is to prevent all flood damages for floods smaller than the design flood,[in most places the 100 year flood]. These include:

1. Outdated Levee System

In 1910 when the levees and bypass system of the Sacramento river Flood Control project [SRFCP], were designed, one of its major objectives was to flush hydraulic mining debris sediments from the Sacramento river channel to restore navigation for river stern wheelers. This was a major factor in choosing to construct levees as close to the river channel as possible, often within the active meander belt of the river and across highly permeable relict river channels. The consequence of this design decision has been eroding and unreliable levees, high maintenance costs, and higher flood stages than occurred naturally. Because the levees were so close to the river, their maintenance activities and repair with rip rap has now destroyed essential riparian habitat along most of the Sacramento River.

2. Flood Peaks Increased

The design of the SRFCP significantly reduced the storage of flood waters within the Sacramento valley. This storage of floodwaters on the floodplain had slowed down and dampened the flood peak as it moved downstream. The engineers of 1910 recognized this effect and estimated that by the time the project was complete the flood peak at the vicinity of Sacramento would increase the design flood from 450,000 cfs

naturally to 600,000 cfs, due to the elimination of floodplain storage. In the 1986 flood the flow in the vicinity of Sacramento was just under 600,000 cfs. Elimination of floodplains also destroyed or disconnected almost all of the Sacramento Valley's extensive floodplain wetlands from the river, destroying a key component of the watershed's ecosystem.

3. Flood Control Encourages Flood Prone Development

At the time the SRFCP was designed the Sacramento Valley was sparsely settled. Where people farmed in the floodplain they took prudent actions to protect themselves, like building ranches on raised ground. It was assumed that overtopping of the levees during the inevitable flood larger than the design flood was an acceptable risk. What was not foreseen was the effect the levees would have to encourage people to develop in the floodplain and neglect traditional flood proofing methods. By the 1940's it was decided that additional flood control was the answer to the growing flood hazard problem and a series of large flood control reservoirs were constructed in the Sacramento and San Joaquin Valleys between the 1940's and 1970's to reduce flood peaks of large floods to the 1910 design capacity of the SRFCP, and the design capacity of the later San Joaquin Flood Control Project, to reduce, but not eliminate, the risk of levee failure. At the time of the design of these reservoirs no consideration was given to the further increase in flood damages likely incurred by people induced to develop in floodplain areas where the risks, while reduced, were still substantial. The construction and operation of these large dams on the Central Valley rivers has probably been the most important cause of wholesale decline in the river and estuarine ecosystem.

4. Flood Control Reservoirs Mis-operated

When these dams were designed in the 1940's and 1950's they were experimental in that there was very little operating experience with dams of this size. Nevertheless, their flood control benefits depended on them being operated exactly to plan during all major floods. Subsequent experience has shown this to be impossible. This assumption did not consider an inherent operational conflict. All these dams were intended as multipurpose reservoirs, to be used for power and irrigation as well as flood control. However, to maximize irrigation and power revenues requires minimizing flood control storage space. Recognizing this conflict, and because federal taxes paid for the less tangible flood control functions, reservoir drawdowns and releases during the winter flood season were specified in federally approved flood control operating manuals. Unfortunately, enforcement of these specified operations has been lax or ineffective and has allowed many dams to illegally store irrigation water in the flood control space during the winter. There is now a history of incidents during major floods on many multipurpose dams like the 1986 Folsom dam mis-operation. Prescribed reservoir releases have been made too little and too late, leading to too large or uncontrolled releases and severely limiting the effectiveness of the flood control dams. Illegal storage of floodwater in this way also has a subtle but important negative environmental effect. It tends to eliminate the natural winter and spring flow variability which sustain important river ecosystem processes.

5. Inadequate Outlet Capacity

In the design of most of the dams outlet capacity is inadequate to allow the most effective use of flood storage space. For example more than half of Folsom Dam's flood storage space must fill before water pressure is great enough to discharge the full flood release.

6. Flood Releases Unrealistically Constrained

In the design of the San Joaquin Valley dams, prescribed flood discharges were so small, less than 10% of the design flood, that almost all the incoming floodwater has to be stored. With only a small amount of flood storage available it is inevitable that these dams will overtop in a large flood or be unable to handle successive small floods. For example in the January 1997 flood the inflow to New Don Pedro Dam was 130,000cfs but the discharge was limited to less than the 9,000cfs design channel capacity, resulting in the reservoir filling and spilling a flood wave of 50,000cfs that broke the levees downstream. This futile attempt to eliminate flood peaks in the lower river has allowed encroachment of vegetation into the old river channel as well as encouraging development in the floodway. This has caused a significant adverse effect on spawning gravels and the riverine ecosystem.

7. Risk of Catastrophic Failure

The design of the flood control system makes almost no provision for addressing the consequences of the inevitable extreme flood larger than the design flood or a flood wave from a dam failure that will overwhelm the system. For example, the design of the levee system establishes a uniform level of protection up to the level of the design flood. In fact, for a flood larger than the design flood the safety of the City of Sacramento would necessarily depend on unanticipated or even deliberate levee failures upstream to achieve lower flood stages at the City. This is a fact that is probably not understood or appreciated by communities upstream.

D. OPPORTUNITIES FOR A NEW FLOOD MANAGEMENT SOLUTION

The January 1997 floods have reconfirmed the lessons of the 1993 Mississippi flood. These lessons are described in the 1994 White House "Galloway Report" and echoed in the 1994 report of the Interagency Floodplain Management Task Force. The essence of a flood management approach is changing the objective from "controlling floods" to the more appropriate one of reducing flood hazards to lives and property. In this strategy, structural flood control measures are a very important, but not the dominant, tool in achieving modern societal goals. Land use controls, flood insurance, building codes, relocation, flood proofing, emergency preparedness, and public education are also important and effective tools. Flood management also requires "management" to substitute for "construction" as the most important activity to protect our

floodplain infrastructure. This in turn emphasizes the need for more sophisticated and effective maintenance, operation, flood warning, training, monitoring, and learning from experience to enable a cycle of constant improvements in the system.

To initiate a new effective flood management strategy will first require a comprehensive unbiased reassessment of the effectiveness of the present system. Such an audit would most likely confirm many of the findings and recommendations of the Galloway Report, but in addition identify some problems unique to California's flood control system. For example, these are some of the improvements that could be made to increase reliability and effectiveness.

1. Redesign dam flood control operation procedures to take into account upstream reservoirs and forecasted inflows to make prompt releases to draw down the reservoir.
2. Modify dam outlets to increase discharge capacity.
3. Increase floodway capacity downstream by setting back levees.
4. Increase flood releases to the expanded floodway capacity.
5. Setback levees on the mainstem rivers to increase floodway capacity, reduce risk of failure, and to provide floodplain storage benefits.
6. Lower flood bypass weirs to lower river stages.
7. Identify planned levee failures and inundation areas for extreme floods or dam failures.
8. Use up to date dynamic flood prediction models that accurately reflect the benefits of floodplain storage.
9. Develop accurate assessments of residual risk of property located on the floodplain but behind levees.
10. Develop levee maintenance and inspection processes that accurately reflect the main risks of failure.
11. Reconstruct levees to improve reliability.

E. OPPORTUNITIES FOR HABITAT RESTORATION

Restoration planning efforts by Calfed and by other investigators all point to the need to restore some portion of the floodplain wetlands and woodlands that have been practically eliminated from the system. Although the science and practice of ecosystem restoration are new, there is a substantial consensus that a prerequisite to the successful restoration of any type of habitat is the restoration of physical processes that sustain the living organisms. For floodplains the key processes are floods, the movement of sediment, and free interaction of flows between river channel and floodplain.

E-014019

To achieve substantive restoration of floodplain wetland processes will therefore require :

1. Setback levees to recreate floodplain corridors.
2. Setback levees to allow for an active natural meander belt.
3. Reconstruction of levees to allow for vegetated toes instead of rip rap.
4. Acquisition of flood bypass land to convert to wetlands.
5. Lowering of bypass weirs to increase frequency of flooding in bypass wetlands.
6. Change in reservoir flood operation to increase frequency of smaller floods.
7. Change in reservoir operation to allow for larger flood pulses to regenerate floodplain woodlands.
8. Increase in frequency of moderate sized floods to reestablish natural riffles, pools and meanders.

F. CONCLUSION

There is an almost perfect overlap between those measures needed for implementing an effective flood management strategy and those needed for meaningful restoration of the Valley's fish and wildlife.